Review Paper On Effect of Seismic Forces on Transmission Line Tower

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***Abstract*— :** *In the contemporary era, the telecommunication industry plays a great role in human societies and thus much more attention is now being paid to telecommunication towers than it was in the past. Many of the towers were failed for seismic load. Once happens the earthquake, the transmission line may collapse, it will cause economic loss, fire and whole society paralyze. In this work, the transmission tower with different bracings (K, cross and diagonal) will be analyzed under seismic loading for two zones viz. zone III and zone IV and three soil conditions Hard, Medium and Loose using STAAD PRO software.*

Index Terms:- *Earthquake zones, Soil conditions, STAAD Pro, Transmission tower.*

I. INTRODUCTION

India has a large population residing all over the country and the electricity supply need of this population creates requirement of a large transmission and distribution system. Also, the disposition of the primary resources for electrical power generation viz., coal, hydro potential is quite uneven, thus again adding to the transmission requirements. Transmission line is an integrated system consisting of conductor subsystem, ground wire subsystem and one subsystem for each category of support structure. Mechanical supports of transmission line represent a significant portion of the cost of the line and they play an important role in the reliable power transmission. They are designed and constructed in wide variety of shapes, types, sizes, configurations and materials. Transmission line tower normally comprise of several hundred- angle members eccentrically connected. Structural analysis of this type of structure requires extensive data generation. Conventional process of data generation in describing the topology, geometry, load and support conditions are very tedious, time consuming and susceptible to error. In general, most towers may be idealized as statically determinate and analyzed for forces. Strong earthquake has serious impact on the safety and reliability of the operation to transmission tower-line system. Once happens the earthquake, the power system will be suffered serious damage, not only cause huge economic loss directly or indirectly, but also can cause secondary disasters, such as fire.

II. SCOPE AND OBJECTIVE

The present work is based on the study of effect of earthquake on Transmission Line Tower. The analysis is based on the two zones III & IV & and three soil conditions Hard, Medium & Loose. The entire modeling, analysis and design is carried out by using STAAD V8.0 version software. The overall specific objectives of this study are:-

- To analyse the Cross braced Transmission Line Tower located in two earthquake zones built on hard, medium and soft soils.
- To analyse the K braced Transmission Line Tower located in two earthquake zones built on hard, medium and soft soils.
- To analyse the diagonal braced Transmission Line Tower located in two earthquake zones built on hard, medium and soft soils.

III. LITERATURE REVIEW

Renju Chandran, Linda Ann Mathew (July 2016)[1], In this work, the structural strength of microwave transmission tower with different steel section (I, C and circular) were analyzed under seismic loading conditions using ANSYS and the best stable steel section was found out. CATIA V5 and ANSYS softwares were used for modelling. CATIA V5 was used to draw the line model of tower then the line model is exported to ANSYS, then properties and loads were assigned. Seismic analysis was done by using frequency response spectrum (FRS). Maximum deformation and maximum stress obtained for circular section was less. Therefore it was concluded that circular section is the most stable steel section.The second stable section observed was channel section.

P. Shivam, et.al, (May 2016)[2], reports the design and analysis of a steel lattice transmission line towers of a power system located in Delhi and Panjim. The design and analysis of the considered power system has been done using STAAD.ProV8i. Delhi and Panjim have same seismic zone but there is a lot of difference in the basic wind speed as Panjim is a coastal area, so this study plays a very important in terms of wind loading. In this paper an attempt has been made to compare the same transmission towers with same bracing system at different wind zones viz. zone II and IV but same seismic zone i.e. zone IV located at Delhi and Panjim. The comparative analysis is carried out with respect to axial force, deflections maximum sectional properties and critical load condition for both the locations. There is large difference in the bending moment forces on the members also there is huge change in the axial force in the cross arm members of the transmission tower in these two locations . Transmission tower with same bracing can be used at these two different wind zones with same seismic zone by using different steel members at different phases of the transmission tower according the effect of the load on the specific location members.

P. Sumit, et.al. (Sep 2014)[3], This paper describes about an analytical comparative study on 1S2 transmission tower under wind and earthquake loads considering optimization technique. The optimization of wind and earthquake load is carried out by plotting graphs between earthquake forces with height, wind forces with height and tower with X and K bracing under wind and seismic load. All the calculation and analysis is carried out using STAAD PRO software and EXCEL spreadsheet.

Ch. Sudheer, et.al. (2013)[4], In this study, an attempt is made that 220kV Transmission line tower is modeled using STADD Pro 2006. The towers are designed in two wind zones I & V with three different base widths 1/4, 1/5 &1/6 of total height of tower. Towers are modeled using parameters such as constant height, bracing system, angle sections and variable parameters of different Base widths and Wind zones. The loads are calculated from IS: 802(1995). After completing the analysis, the comparative study is done with respect to deflections, stresses, axial forces and weight of tower for all 6 different towers. In this work the height of tower is taken as 33.52m and the three corresponding base widths with respect to height are 8.38m, 6.704m and 5.587m.

P. Gopi Sudam (Jan 2014)[5], In this thesis Analysis and Design of narrow based Transmission Tower (using Multi Voltage Multi Circuit) is carried out keeping in view to supply optimum utilization of electric supply. In this project, an attempt has been made to make the transmission line more cost effective keeping in view to provide optimum electric supply for the required area. The objective of this research is met by choosing a 220KV and 110KV Multi Voltage Multi Circuit with narrow based Self Supporting Lattice Towers. Using STAAD PRO v8i analysis and design of tower has been carried out as a three dimensional structure. In this work the height of tower is taken as 53 95m. Base width is 1/8 of total height i.e. say 6m and width at waist level is 1/2 of base width i.e. 3m (standard practice in use). Inclination at base = 2.419.

C. Preeti and K. Jagan Mohan (Aug 2013)[6], Transmission line towers constitute about 28 to 42 percent of the cost of the transmission line. The increasing demand for electrical energy can be met more economically by developing different light-weight configurations of transmission line towers. In this report, an attempt has been made to make the transmission line more cost effective by changing the geometry (shape) and behavior (type) of transmission line structure. This objective is met

by choosing a 220 kV single circuit transmission line carrying square base self-supporting towers. With a view to optimize the existing geometry, one of these suspension towers is replaced by a triangular base self-supporting tower. Then, the structural behavior of existing tower is looked upon by developing a square base guyed mast. Using STAAD, analysis of each of these three towers has been carried out as a three-dimensional structure. Then, the tower members are designed as angle sections. For optimizing any member section, the entire wind load computations have to be repeated, simultaneously for the analysis and design. Then, all these three towers are compared and analyzed. Using triangular base self-supporting tower will bring a saving of 9.23% in the weight of structural steel, and using square base guyed mast will lead to a saving of 39.96% in the structural steel which is the structural optimization of the transmission line.

V. Lakshmi, A. Rajagopala Rao (Jul-Aug 2012)[7] , In this paper the performance of 21M high 132kV tower with medium wind intensity is observed. The Recommendations of IS 875-1987, Basic wind speeds, Influence of height above ground and terrain, Design wind speed, Design wind pressure, Design wind force is explained in detailed. An analysis is carried out for the tower and the performance of the tower and the member forces in all the vertical, horizontal and diagonal members are evaluated. The critical elements among each of three groups are identified. The details of load calculation, modeling and analysis are discussed. The wind intensity converted into point loads and loads are applied at panel joints. Configuration of the structure of the tower plays a vital role in its performance especially while considering eccentric loading conditions. The bottom tier members have more role in performance of the tower in taking axial forces and the members supporting the cables are likely to have localized role. The vertical members are more prominent in taking the loads of the tower than the horizontal and diagonal members. The members supporting the cables at higher elevation are likely to have larger influence on the behavior of the tower structure. The effect of twisting moment of the intact structure is not significant.

G. Visweswara Rao (1995)[8] , A method for the development of optimized tower designs for extra high-voltage transmission lines is presented in the paper. The optimization is with reference to both tower weight and geometry. It is achieved by the control of a chosen set of key design parameters. Fuzziness in the definition of these control variables is also included in the design process . A derivative free method of nonlinear optimization is incorporated in the program, specially developed for the configuration, analysis and design of transmission line towers. A few interesting result of both crisp and fuzzy optimization, relevant to the design of a typical double circuit transmission line tower under multiple loading condition, are presented.

IV. CONCLUSION

From the above literature, it is concluded that

- The Lateral circular section is the most stable section and channel section is the stable section.
- The bottom tier members have more role in performance of the tower in taking axial forces and the members supporting the cables are likely to have localized role.
- The vertical members are more prominent in taking the loads of the tower than the horizontal and diagonal members.
- The analysis is carried out using STAAD Pro software.

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